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High Catalysis Activity of Cu_2O Microcrystals to the Electrochemiluminesence of Luminol and H_2O_2

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Cuprous oxide (Cu_2O) is a classical p-type semiconductor with a direct band gap of 2.17 eV, which is wildly used for solar energy conversion, CO oxidation, and photo catalytic water splitting for the low cost and environmental friendliness.[1] For the energy band positions are favorable to the hydrogen evolution and oxygen evolution potentials, Cu_2O materials also catalyze the reduction of hydrogen peroxide (H_2O_2), which is an critical molecule in the bodies' metabolism processes or the industrial catalysis reactions.[2] To improve detection sensitivity of H_2O_2, people have composed Cu_2O materials with Ag nanoparticles or graphene nanosheets, which are sophisticated and cost.[3] Herein, we use the electrochemiluminescence (ECL) method to improve the sensitivity of the reaction catalyzed by Cu_2O microcrystals. As shown by Figure 1A, the ECL reaction of H_2O_2 and luminol catalyzed by Cu_2O octahedra (Figure 1B) is strong at the potential of – 0.2 V (vs. Ag/AgCl). And the corresponding current of the reaction is not obvious (Figure 1A, inset). We also check the effect of copper ions (Cu^{2+}) to the ECL reaction, and there is much lower catalytic activity to the ECL reaction by Cu^{2+} ions. It indicates that Cu_2O semiconductor microcrystal possess the good catalytic performance to this ECL reaction, which is important to develop the high-efficient and low-cost biosensors.

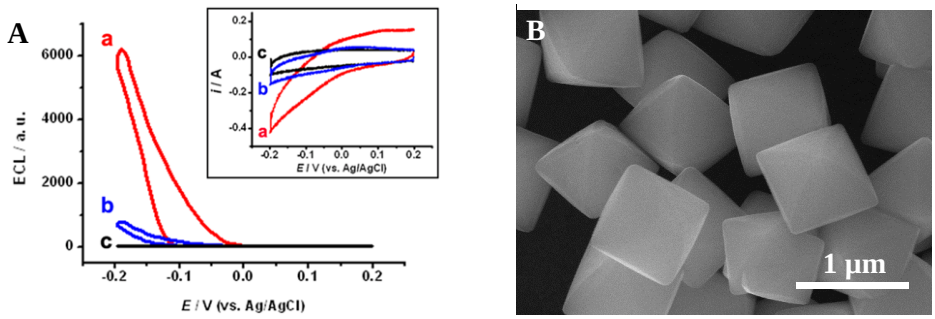

Figure 1. (A) ECL-potential curves of (a) 100 µM luminol and 100 µM H_2O_2 solution on the Cu_2O modified glassy carbon electrode (GCE), (b) 100 µM luminol, 100 µM H_2O_2, and 100 µM Cu^{2+} solution on GCE, and (c) 100 µM luminol and 100 µM H_2O_2 solution on GCE. Phosphate buffer, 50 mM, pH 7.4. Inset, corresponding cyclic voltammograms, scan rate. 50 $mV \cdot s^{-1}$. (B) Scanning electronic microscopy image of octahedral Cu_2O microcrystals.

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